

## PATENT COOPERATION TREATY

PCT

REC'D 29 APR 2005

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P32391ACCI/GMU	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. PCT/GB2004/001443	International filing date (day/month/year) 02.04.2004	Priority date (day/month/year) 04.04.2003
International Patent Classification (IPC) or national classification and IPC F03B13/20		
Applicant OCEAN POWER DELIVERY LIMITED et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> <i>sent to the applicant and to the International Bureau</i> a total of 11 sheets, as follows:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</li> <li><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</li> </ul> <p>b. <input type="checkbox"/> <i>(sent to the International Bureau only)</i> a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following Items:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Box No. I Basis of the opinion</li> <li><input type="checkbox"/> Box No. II Priority</li> <li><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li><input type="checkbox"/> Box No. IV Lack of unity of invention</li> <li><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li><input type="checkbox"/> Box No. VI Certain documents cited</li> <li><input type="checkbox"/> Box No. VII Certain defects in the international application</li> <li><input type="checkbox"/> Box No. VIII Certain observations on the international application</li> </ul>		
Date of submission of the demand 04.02.2005	Date of completion of this report 02.05.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  de Rooij, M Telephone No. +31 70 340-2306	



## **INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**

International application No.  
PCT/GB2004/001443

## **Box No. I Basis of the report**

- With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
    - This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
      - international search (under Rules 12.3 and 23.1(b))
      - publication of the international application (under Rule 12.4)
      - international preliminary examination (under Rules 55.2 and/or 55.3)
  - With regard to the elements\* of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

**Description, Pages**

1-29 as originally filed

## **Claims, Numbers**

1-34 filed with telefax on 18.02.2005

## **Drawings, Sheets**

2/12-5/12, 8/12-12/12 as originally filed

1/12, 6/12, 7/12 filed with telefax on 18.02.2005

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3.  The amendments have resulted in the cancellation of:  
 the description, pages  
 the claims, Nos.  
 the drawings, sheets/figs  
 the sequence listing (*specify*):  
 any table(s) related to sequence listing (*specify*):

4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).  
 the description, pages  
 the claims, Nos.  
 the drawings, sheets/figs  
 the sequence listing (*specify*):  
 any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2004/001443

**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-34
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-34
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-34
	No:	Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

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PCT/GB2004/001443

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following documents:

D1: US-B1-6 476 511 (PIZER DAVID ET AL) 5 November 2002

2. The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document):

A wave power apparatus comprising:

a plurality of buoyant elongate body members, adjacent pairs of body members being interconnected to form an articulated chain, each body member of said pair being connected by linkage means permitting relative rotation of the body member;

power extraction means adapted to resist and extract power from the relative rotation within the linkage means;

wherein the linkage means at the one end of a first body member permit relative rotation about a first axis of rotation and the linkage means at a second end of the first body member permit relative rotation about a second axis of rotation.

3. The subject-matter of claim 1 differs from this known wave power apparatus in that adjacent pairs of body members are interconnected by a linkage unit and the power extraction means are located substantially within this linkage unit.

4. The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

5. The problem to be solved by the present invention may be regarded as to simplify manufacture, transportation and testing of the wave power apparatus.

6. The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

Manufacturing separate linkage units between each body member requires significant non-obvious structural changes to the body members and also a different working principle of

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the apparatus. The body members do not move relative to each other, rather they move relative to linkage units between the body members.

By providing these separate linkage units, the apparatus can be assembled on site, and testing of the power extraction means only requires the linkage units, not all the body members.

7. The same reasoning applies, mutatis mutandis, to the subject-matter of independent claims 21, 31 and 32, which are therefore also considered new and inventive (Article 33(2) and 33(3) PCT).

8. Claims 2-20, 22-30, 33 and 34 are dependent on at least one of the claims 1, 21, 33 and 34 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

1      Claims

2

3      1. Wave power apparatus comprising:

4

5                a plurality of buoyant elongate body  
6                members, at least one adjacent pair of body  
7                members being interconnected by a linkage unit  
8                to form an articulated chain, each body member  
9                of said pair being connected to the respective  
10          linkage unit by linkage means permitting  
11          relative rotation of the body members;

12

13                power extraction means adapted to resist  
14                and extract power from the relative rotation,  
15                the power extraction means being located  
16                substantially within each linkage unit; and

17

18                wherein each linkage unit is arranged to  
19                permit relative rotation between the linkage  
20                unit and a first body member about a first axis  
21                of rotation at a first end of the linkage unit,  
22                and to permit relative rotation between the  
23                linkage unit and a second body member about a  
24                second axis of rotation at a second end of the  
25                linkage unit.

26

27      2. Apparatus as claimed in claim 1, wherein the body  
28      members are arranged consecutively in an articulated  
29      apparatus, each adjacent pair of body members being  
30      interconnected by a linkage unit to form an  
31      articulated chain.

32

1       3. Apparatus as claimed in claim 1 or 2, wherein the  
2       or each linkage unit has a longitudinal length  
3       substantially shorter than the body members.

4

5       4. Apparatus as claimed in any preceding claim, in  
6       which the body members substantially comprise hollow  
7       members devoid of active components.

8

9       5. Apparatus as claimed in any preceding claim,  
10      wherein each body member has one or more end caps  
11      with corresponding linkage means to marry with the  
12      linkage means of the linkage unit.

13

14      6. Apparatus as claimed in any preceding claim,  
15      wherein the power extraction means includes a  
16      hydraulic ram assembly.

17

18      7. Apparatus as claimed in claim 6, wherein the  
19      hydraulic ram assembly comprises a plurality of  
20      rams.

21

22      8. Apparatus as claimed in claim 6 or 7, wherein the  
23      power extraction means includes a hydraulic ram  
24      assembly for each axis of rotation.

25

26      9. Apparatus as claimed in claim 8, wherein the  
27      power extraction means includes two hydraulic ram  
28      assemblies acting about each axis of rotation.

29

30      10. Apparatus as claimed in claim 5, wherein the end  
31      caps have a number of cavities to receive respective  
32      ends of the power extraction means.

1

2       11. Apparatus as claimed in any preceding claim,  
3       wherein the power extraction means has at least one  
4       seal to prevent ingress of water into the linkage  
5       unit and/or body members.

6

7       12. Apparatus as claimed in any preceding claim,  
8       wherein the linkage unit includes one or more power  
9       generation or storage means connected to one or more  
10      of the power extraction means.

11

12      13. Apparatus as claimed in claim 12, wherein the  
13      linkage unit includes a first power generation means  
14      connected to one or more power extraction means at  
15      one axis of rotation, and a second power generation  
16      means connected to one or more power extraction  
17      means at the other axis of rotation.

18

19      14. Apparatus as claimed in claim 13, wherein the  
20      first or second power generation means is  
21      connectable to at least one power extraction means  
22      from each axis of rotation, such that the restraint  
23      of the linkage unit is maintained in the event of  
24      failure of one of the power extraction or generation  
25      means.

26

27      15. Apparatus as claimed in claim 13, wherein the  
28      first and second power generation means is  
29      connectable to one or more of the power extraction  
30      means from one or both axes of rotation, such that  
31      when the apparatus is operating at partial capacity,  
32      the one or more power extraction means is connected

1       solely to the first or second power generation  
2       means.

3

4       16. Apparatus as claimed in any preceding claim,  
5       wherein constraint is applied to each power  
6       extraction means of the linkage unit in order to  
7       induce a cross-coupled response which may be tuned  
8       to be resonant in small waves to increase power  
9       capture and which may be set in large waves to limit  
10      power absorption and maximise survivability.

11

12      17. Apparatus as claimed in any preceding claim,  
13      wherein the apparatus includes one or more of a  
14      ballasting system, mooring system, and means to  
15      apply a roll bias angle to the axes of rotation.

16

17      18. Apparatus as claimed in any preceding claim,  
18      wherein the linkage unit includes access means, such  
19      as one or more hatches, to allow inspection, repair  
20      and maintenance on or off site.

21

22      19. A linkage unit for use in the apparatus of claim  
23      1, comprising:

24

25           linkage means for interconnection between  
26           the body members permitting relative rotation  
27           at either end of the unit;

28

29           power extraction means adapted to resist  
30           and extract power from the relative rotation of  
31           the body members;

32

1           the power extraction means being located  
2           substantially within the linkage unit; and

3

4           wherein the linkage unit is arranged to  
5           permit relative rotation between the linkage  
6           unit and a first body member about a first axis  
7           of rotation at a first end of the linkage unit,  
8           and to permit relative rotation between the  
9           linkage unit and a second body member about a  
10          second axis of rotation at a second end of the  
11          linkage unit.

12

13         20. A linkage unit as claimed in claim 19, wherein  
14           the power extraction means includes a hydraulic ram  
15           assembly.

16

17         21. Apparatus as claimed in claim 20, wherein the  
18           hydraulic ram assembly comprises a plurality of  
19           rams.

20

21         22. A linkage unit as claimed in claim 21, wherein  
22           the power extraction means includes a hydraulic ram  
23           assembly for each axis of rotation.

24

25         23. A linkage unit as claimed in claim 22, wherein  
26           the power extraction means includes two hydraulic  
27           ram assemblies acting about each axis of rotation.

28

29         24. A linkage unit as claimed in any of claims 19 to  
30           23, wherein the power extraction means has at least  
31           one seal to prevent ingress of water into the  
32           linkage unit and/or body members.

1

2       25. A linkage unit as claimed in any of claims 19 to  
3       24, wherein the linkage unit includes one or more  
4       power generation or storage means connected to one  
5       or more of the power extraction means.

6

7       26. A linkage unit as claimed in claim 25, wherein  
8       the linkage unit includes a first power generation  
9       means connected to one or more power extraction  
10      means at one axis of rotation, and a second power  
11      generation means connected to one or more power  
12      extraction means at the other axis of rotation.

13

14       27. A linkage unit as claimed in claim 26, wherein  
15       the first or second power generation means is  
16       connectable to at least one power extraction means  
17       from each axis of rotation, such that the restraint  
18       of the linkage unit is maintained in the event of  
19       failure of one of the power extraction or generation  
20       means.

21

22       28. A linkage unit as claimed in claim 27, wherein  
23       the first and second power generation means is  
24       connectable to one or more of the power extraction  
25       means from one or both axes of rotation, such that  
26       when the apparatus is operating at partial capacity,  
27       the one or more power extraction means is connected  
28       solely to the first or second power generation  
29       means.

30

31       29. A linkage unit as claimed in any of claims 19 to  
32       28, wherein constraint is applied to each power

1 extraction means of the linkage unit in order to  
2 induce a cross-coupled response which may be tuned  
3 to be resonant in small waves to increase power  
4 capture and which may be set in large waves to limit  
5 power absorption and maximise survivability.

6

7 30. A linkage unit as claimed in any of claims 19 to  
8 29, including access means, such as one or more  
9 hatches, to allow inspection, repair and maintenance  
10 on site.

11

12 31. A method of extracting power from waves  
13 comprising the steps of:

14

15 deploying an apparatus as claimed in any  
16 of claims 1 to 18;

17

18 orientating the structure such that a front end  
19 of the structure faces into the oncoming waves;  
20 and

21

22 extracting the power absorbed in the or each  
23 linkage unit.

24

25 32. A method of manufacture of apparatus according  
26 to claims 1 to 18, comprising the step of:

27

28 interconnecting each pair of adjacent body  
29 members of the apparatus with a linkage unit  
30 according to claims 19 to 30.

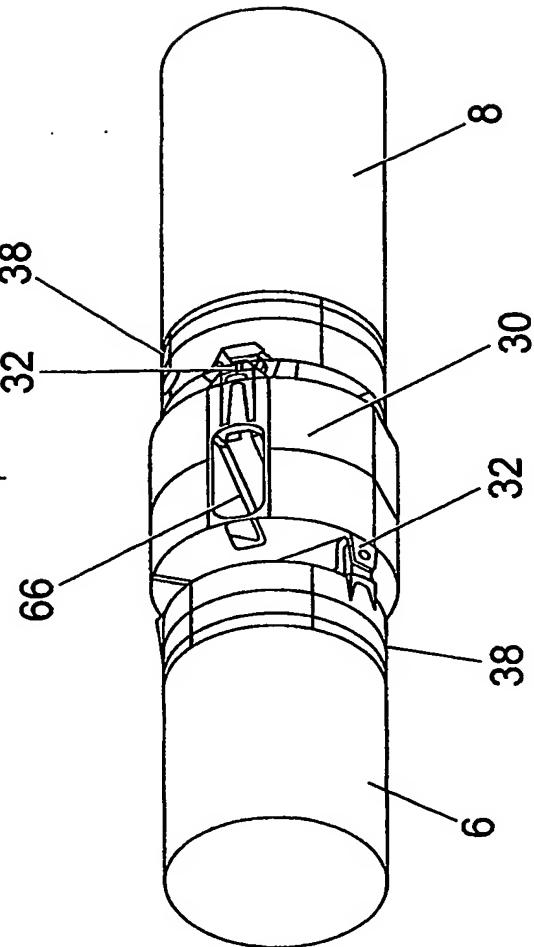
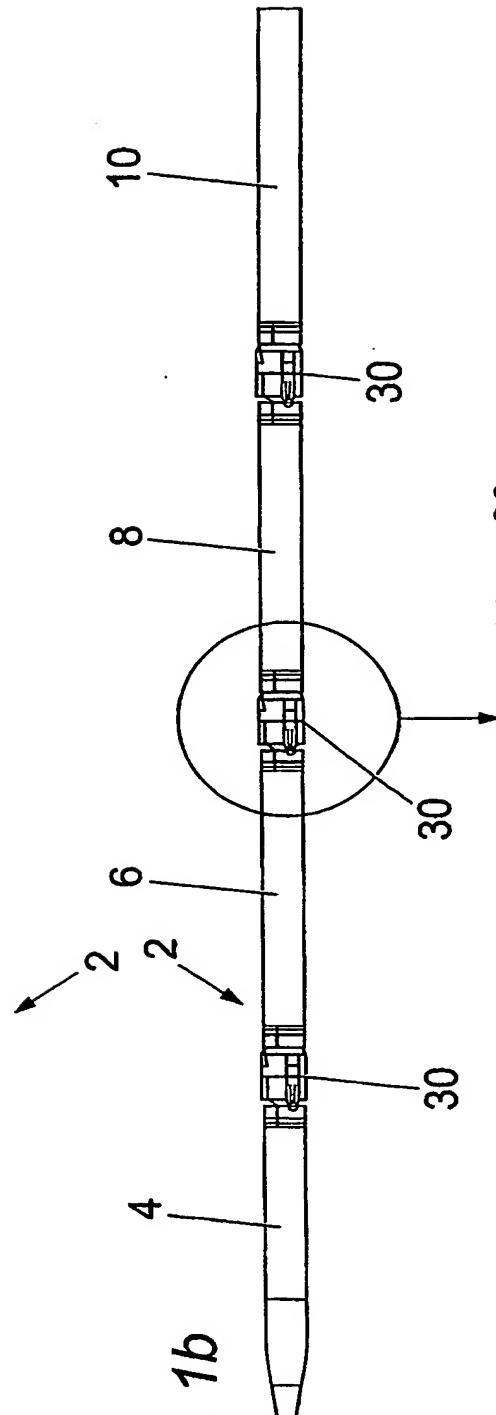
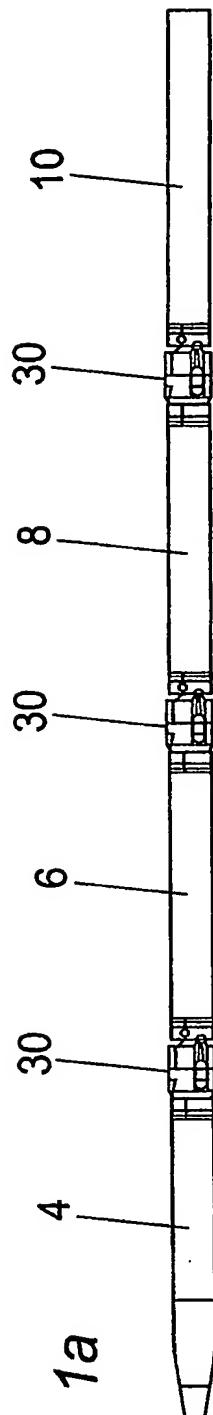
31

1       33. The method of claim 32, wherein the body members  
2       and linkage unit(s) are connected together close to  
3       or on site.

4

5       34. The method of claim 32, wherein the linkage  
6       unit(s) are fully assembled and tested before being  
7       transported to site.

1 / 12



6 / 12

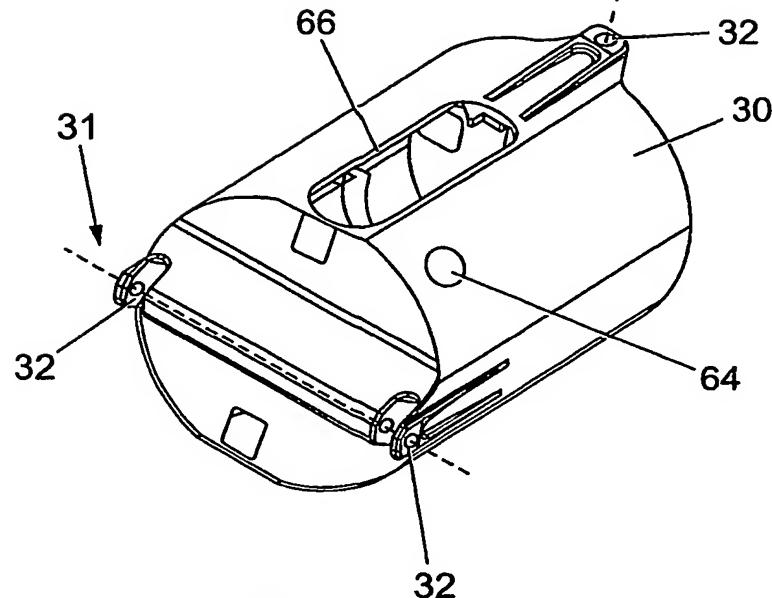


Fig. 7

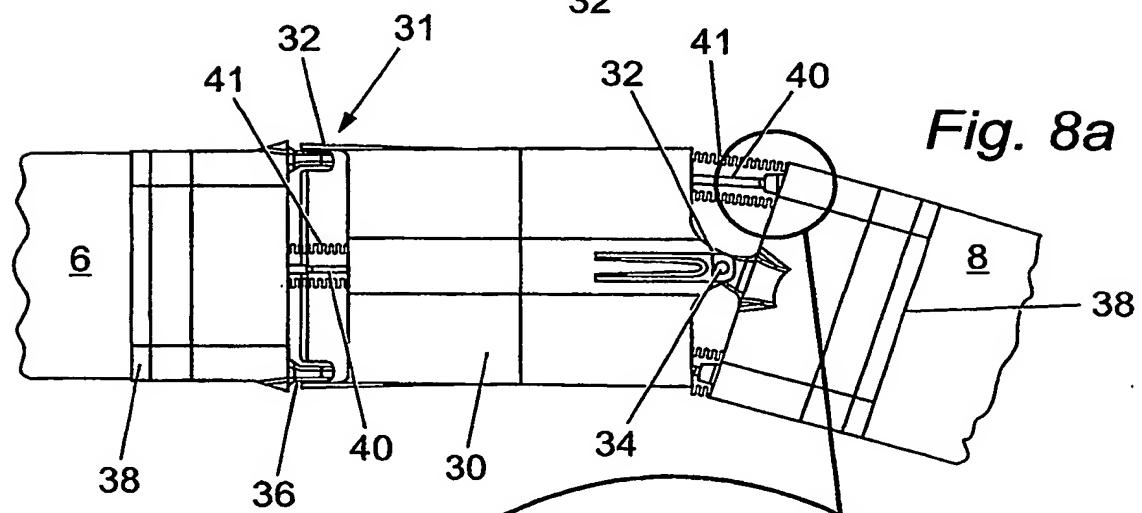


Fig. 8a

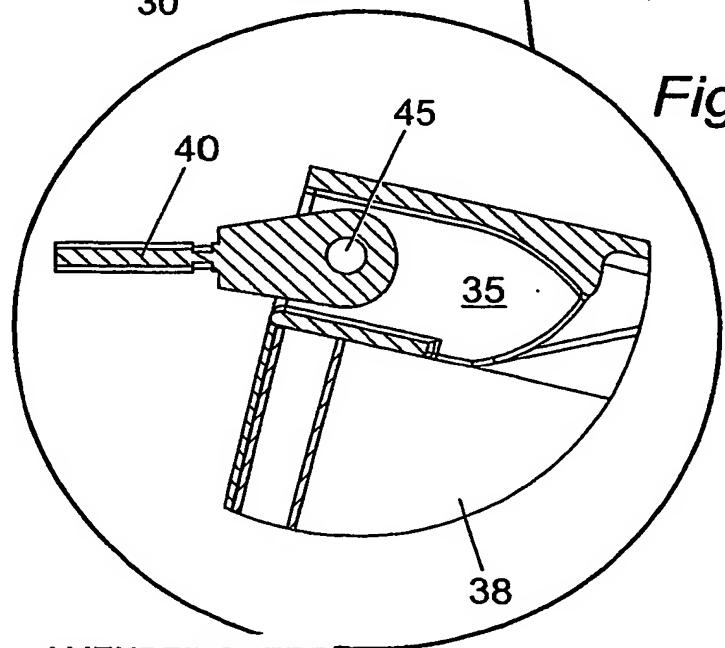


Fig. 8b

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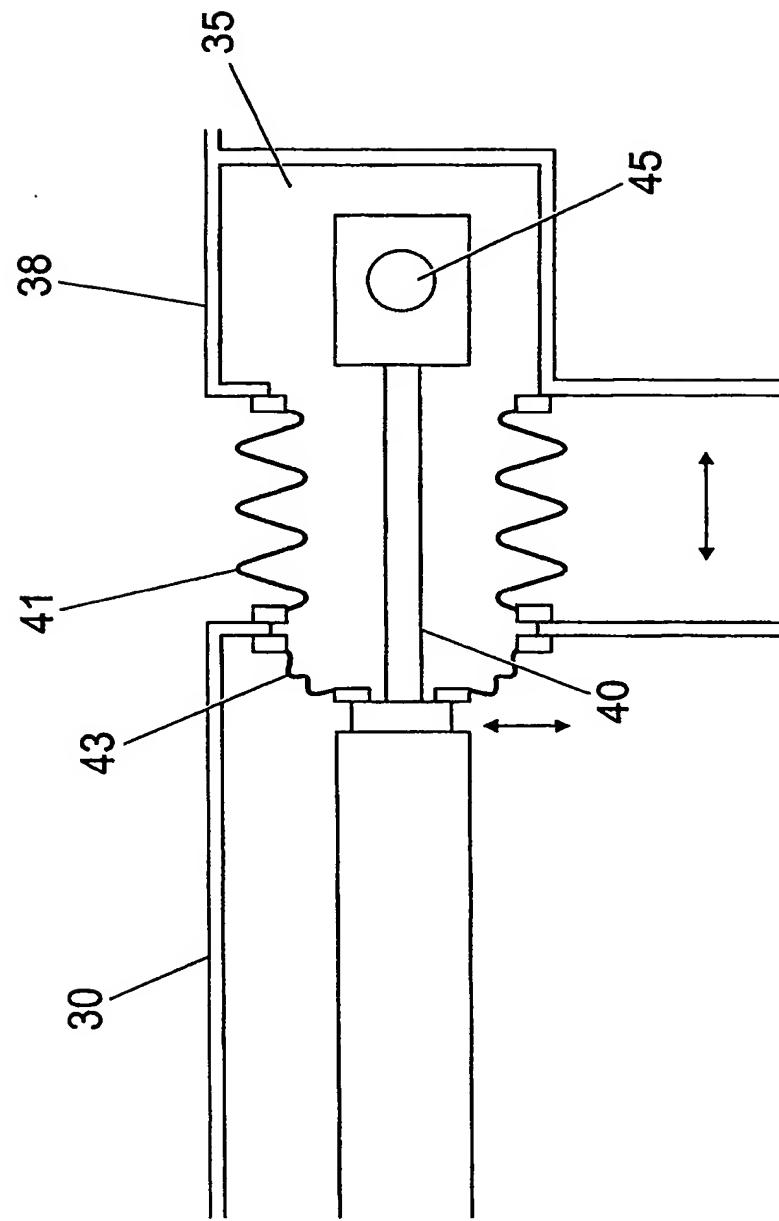


Fig. 8c